Accordingly, the applicant contends that the rejected claims depending from amended claims 1 and 25 are allowable based on their dependency from an allowable claim.

In the Summary of the Invention of the cited Dogan patent (6,018,317) it points out that: "the invention comprises a signal receiving system, including .... an estimated generalized steering vector (EGSV) generator ... that depends on fourth or higher even-order statistical cumulants derived from the received signals, .." (col. 8, l. 52 – 59). The fourth order cumulants of the Dogan invention are described at (col. 32, l. 32 et seq)(col. 47, l. 7 et seq)(col. 78, l. 56 and through columns 79 and 80)(col. 82, l. 15 et seq)(col. 81, l. 63 et seq). The fourth order cumulants of Dogan are "statistical moments of the received signals." and are "formed into a vector, which upon normalization, becomes the EGSV for the next iteration of signal processing. This iteration cycle is repeated until convergence is attained.... of one of the incident source signals." (col. 16, l. 38 – 46) There are many other places in the Dogan specification where the iterative processing of the steering vectors (EGSVs) is described in detail and how the iterations of the EGSVs are used for generating a plurality (P) of receive weight vectors that are then used to recover co-channel interfering signals.

At (col. 8, l. 52 – 63) in Dogan it describes that: "... the system of the invention comprises a signal receiving system, including means for generating a set of conditioned receiver signals from received signals of any modulation or type; an estimated generalized steering vector (EGSV) generator, for computing an EGSV that results in optimization of a utility function that depends on fourth or higher even-order statistical cumulants derived from the received signals, the EGSV being indicative of a combination of signals received at the sensors from a signal source; and a supplemental computation module, for deriving at least one output quantity of interest from the conditioned receiver signals and the EGSV."

Starting at (col. 8, l. 64) it describes that there are two iterative and one direct computation method for computing the EGSVs. All these methods utilize the "fourth or higher even-order statistical cumulants derived from the received signals". This term is used in many

locations throughout Dogan to describe how the EGSVs are updated to be used to obtain receive weights used to recover co-channel interfering signals.

For the first iterative method example the EGSV for each received signal is used by the supplemental computation module 24A to "separate recovered signals on lines 38." (col. 20, l. 59 – 61) This is repeated at (col. 10, l. 30 – 37) where it states: "...the supplemental computation module includes a recovery beamformer weight vector computation module, for generating from all of the EGSVs a plurality (P) of receive weight vectors, and a plurality (P) of recovery beamformers, each coupled to receive one of the P receive weight vectors and the conditioned receiver signals, for generating a plurality (P) of recovered signals."

For the second iterative method the EGSVs are used for the same purpose of recovering received signals. At (col. 10, l. 44 – 50) we read: "...the supplemental computation module includes a recovery beamformer weight vector computation module, for generating from all of the EGSVs a plurality (P) of receive weight vectors, and a plurality (P) of recovery beamformers, each coupled to receive one of the P receive weight vectors and the conditioned receiver signals, for generating a plurality (P) of recovered signals."

For the direct processing method we read at (col. 10. l. 56 – 62) we read: "... the supplemental computation module includes a recovery beamformer weight vector computation module, for generating from both of the EGSVs two receive weight vectors, and two recovery beamformers, each coupled to receive one of the receive weight vectors and the conditioned receiver signals, for generating two recovered signals." The direct processing method can only recover a maximum of two signals. At (col. 20, l. 25 – 28) it states that: "The EGSV computation module 22' computes the solutions to a fourth degree polynomial equation, from which the EGSVs of one or two sources are directly determined." At line 38 it mentions that the EGSVs are used to recover the received signals.

Thus, the processing iterations are used to update the EGSV value which is then used to get weight vectors used to recover signals.

Received signals are all digitized to be processed and this is all done in the time domain using fourth or higher even-order statistical cumulants derived from the received signals. The applicant has used a search program in MS Word to look at each appearance of the word frequency in the text version of the Dogan reference downloaded from the patent office. The word "frequency" is only used in the Dogan reference regarding the frequency of received signals and frequency bands, but never regarding processing of the received signals after they have been received and digitized, and never regarding the processing of the EGSVs to get weights to be used to recover signals.

The Examiner states that: "Dogan et al further discloses wherein step (g) comprises the steps of: (j) performing time domain processing on the eigenstreams (fig. 49 and 50); and (k) performing frequency domain processing on the eigenstreams (fig. 45-47)." The applicant respectfully disagrees with the Examiner. When reading the Dogan specification regarding Figures 45 – 50 we first read in the Description of the Drawings:

> "FIGS. 45 and 46 are spectra of first and second frequency-modulated (FM) sources as used in simulation experiments using the invention."
>
> "FIG. 47 is a spectrum of an amplitude-modulated (AM) source as used in the simulation experiments."
>
> "FIG. 48 is a graph of direction estimates obtained from active ports in the simulation experiments."
>
> "FIG. 49 is a graph of samples of an original speech waveform as used in the simulation experiments."
>
> "FIG. 50 is a graph of samples of a recovered waveform as used in the simulation experiments."

These figures show waveforms of signals, and a graph in Fig. 48, and have nothing to do with iterative processing in the frequency domain, coupled with processing in the time domain to separate interfering signals. The detailed description regarding these figures confirms this. See col. 100, l. 62 et seq.

In the Dogan reference we find many instances, such as at col. 29, l. 36, where it mentions a term "s(t)" and indicates that it is a "time-varying signal". Also, at col . 29, l. 27 – 33 where it mentions that the "received signal" (which is in time domain) is represented by a given equation and all the terms in the equation have "(t)". All terms with "(t)" are time varying. It is a standard practice in the art to represent time domain functions with a "(t)" appended thereto. Similarly, in the art it is standard practice to represent frequency domain function with a "(f)" appended thereto. When we look at the various equations in Dogan we find the terms are in terms of time and "(t)" is appended thereto. There are no terms in any of the Dogan equations with an "(f)" appended thereto. In addition, there is nothing else in the Dogan reference that even suggests doing any processing in the frequency domain.

As previously mentioned a search of the Dogan reference for the word frequency finds no instance of the use of the word "frequency" for other than the frequency of received signals and frequency bands. Thus, there is no frequency domain processing involved for the determination of signal weights used to separate co-channel interfering signals – or for any other purpose.

Although there are a number of similarities in the operation between the operation of the present invention and the invention taught in Dogan, the applicant's novel difference is in how he performs iterative processing in time domain and frequency domain to update antenna beam forming weights that are then used to separate co-channel interfering signals.

First, it is emphasized that the applicant utilizes no <u>fourth or higher even-order</u> statistical cumulants derived from the received signals to determine weights used to separate received signals. Rather, a copy capture algorithm (CCA) captures and copies co-channel interfering signals by a union of fast Fourier transform (FFT) frequency domain processing and non-linear time domain processing. (page 5, l. 12 – 15) At page 9, l. 5 – 7 we read: "The CCA time and frequency domain processing uses normalized spectral bin $f(\omega_i) / | f(\omega_i) |$ and $f(t_i) / | f(t_i) |$ multiplications to capture the strongest signal at each step, for each output, as the beam former converges." There is nothing like this taught or even remotely suggested in the Dogan patent.

At p.18, l.30 through p.19, l.10 in applicant's specification we read:

> "The adaptive <u>U weight convergence sequence</u> described in detail above is shown in a more concise pair of processing loops shown in Figure 4. Threshold factors T_{ht} and T_{hf} are key for optimum adaptive processing and they determine the signal components that contribute in the capture process. These functions are shown in Figure 4 in the lines:
>
> if abs (CopyT(ns, it)) > threshold T_{ht}, then B(ns,it) = 1
> YT(k, it) = B(ns, it) x ([CopyT(ns, it)] / [|CopyT(ns, it)|])
> and
> if abs (CopyF(ns, if)) > threshold T_{hf}, then B(ns, if) =1
> YF(ns, if) = B(k, if) x ([CopyF(ns, if)] / [|(CopyF(ns, if)|]
>
> "The CCA time and frequency domain processing uses normalized spectral bin $f(\omega_i) / | f(\omega_i) |$ and $f(t_i) / | f(t_i) |$ multiplications to capture the strongest signal at each step, for each output, as the beam former converges. Time domain and fast Fourier transform bin thresholding is the key to the capture process, and only strong spectral and time domain complex samples are used as product elements for each new iteration of eigenstream processing."

In mathematics, the continuous Fourier transform is an operation that <u>transforms</u> one function of a real variable into another. The new function, often called the <u>frequency domain</u> representation of the original function, describes which frequencies are present in the original function. The Dogan reference does not teach or suggest the use of Fourier transforms in the iterative processing to get beam forming weights used to capture / separate received signals.

See also page 13, l. 1 – 9 and page 14, l. 2 – 8 in applicant's specification, in conjunction with the above, about how he iteratively uses time domain processing and frequency domain processing (fast Fourier transforms) to get the beam forming weights.

The Examiner cites the Dogan patent "in view of Gardner et al (US 5,299,148)" in the opening of paragraph 2 of the Office action. In paragraph 2 the Examiner thereafter only mentions the Gardner et al patent in conjunction with Dogan regarding "a priori knowledge". Since "a priori knowledge" is not being argued by the applicant the Gardner et al patent is not discussed. The applicant has carefully reviewed the Gardner et al patent and does not believe

that it suggests or teaches the applicant's invention, which is described above, either alone or in combination with the Dogan reference.

In paragraph 2 of the Office action the Examiner rejects claims 8 and 18 "under 35 U.S.C. 103(a) as being unpatentable over Dogan et al (US 601 831 7) in view of Gardner et al (US 52991 48) as applied in claims 6 and 12 above, and further in view of Papadias et al ("New adaptive blind equalization algorithms for constant modulus constellation", Acoustics, Speech, and Signal Processing, 1994. ICASSP-94., 1994 IEEE International Conference on, Vol. lii, 19-22 April 1994 Page(s): III/321- III/324 Vol. 3)."

Continuing, the Examiner states that:

> "Dogan et al as modified by Gardner et al discloses all of the subject matter discussed above, but for explicitly teaching wherein either step (j) or (k) may be eliminated when there is a priori knowledge of a received signal being a constant modulus or non-constant modulus signal."
> "However, Papadias et al discloses a priori knowledge of a received signal being a constant modulus signal (see abstract)."

The Examiner then concludes that: "It would have been obvious to one of ordinary skill in the art at the time of the invention to have incorporated the method of Papadias et al in the method of Dogan et al as modified by Gardner et al in order to provide an algorithm that escape from undesirable local minima of their cost function for the benefit of stability."

The previously described the applicant has amended independent claim 1, from which claims 8 and 18 depend, to clearly claim his novel time and frequency domain iterative processing. The reasons that this is novel have been carefully presented above.

Accordingly, the applicant contends that claims 8 and 18 are allowable based on their dependency from an allowable claim.

The Examiner finally cites Tsutsui et al (US 6385181) as prior art made of record and not relied upon. The applicant has reviewed this patent and does not believe that it alone, or in any combination with the other patents and papers cited by the Examiner, teaches or suggest the applicant's invention as now claimed in amended independent claims 1 and 25.

In summary, the applicant has deleted claims 27, 28 and 31 – 34 and amended independent claims 1 and 25 are now believed to be allowable for the reasons described in this response.

If there are any questions the Office is invited and authorized to contact the undersigned attorney via telephone at (603) 432-8788, via fax at (603) 421-2779, or via e-mail at jfunk777@comcast.net.

Sincerely,

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